BELLSOUTH ATTACHMENT 1

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PRICE CAP PERFORMANCE REVIEW FOR LECS

CC Docket No. 94-1

Comment of Professor Frank M. Gollop on Productivity Offset:
Issue 19B of Second FNPRM and Issue 4 of Fourth FNPRM
Single Industry vs. Multiple 'X' Factors

I. INTRODUCTION AND SUMMARY OF MAJOR CONCLUSIONS

The role of the X-factor(s) is to serve as a surrogate for the efficiency-enhancing incentives that would be operative in a fully dynamic competitive market. It is to be the mechanical heart mimicking competitive Darwinian pressures. The relevant question is how to establish 'X'.

> **Issue 4, Fourth FNPRM:** Should there be multiple X-Factors in the long-term price cap plan and, if so, how many should there be and how should they be determined?

The Commission has tentatively concluded that 'X' be modeled as a single industry average. Paragraphs 109 and 110 of the FNPRM seek comments on a single X-factor versus two alternative regimes: (i) X-factors individually tailored to each price-cap LEC and (ii) a set of multiple X-factors established for subsets of "like" LECs via adjustments to a single industry 'X'.

This comment presents a comparative evaluation of these three competing models and reaches the following 15 major conclusions:

1. A single industry-average X-factor based on moving averages is superior to any model of LEC-specific or multiple X-factors. A single industry 'X' induces LECs to maximize their productivity growth, is administratively simple, and guarantees that on-going productivity gains by the LECs are passed through to ratepayers.

2. The X-factor must be beyond each LEC's control. When its 'X' is tailored to its own performance, each LEC has the incentive to engage in strategic behavior. Each LEC can affect its 'X' in future years by modifying its current behavior.

3. LEC-specific paradigms are condemned by the fact that they effectively tax superior performance with rising X-factors and subsidize inferior performance with reduced X-factors.

4. LEC-specific X-factors, in contrast to the hallmark characteristic of price-taking behavior in a competitive marketplace, give LECs market power--their behavior today can affect their future 'X' and hence prices.

5. Calculating a single industry-average 'X' does not require distinguishing business conditions that are within versus those that are beyond the firm's control. A multiple-X adjustment paradigm does have this requirement since any adjustment to industry-average 'X' applied to individual LECs must be based only on factors beyond the LECs' control.

6. In the case of multiple X-factors applied to subsets of LECs, unless both the 'X' adjustment factors and the assignment of LECs to homogeneous subsets are derived correctly on the basis of persistent business conditions beyond the LECs' control, the use of multiple X-factors will formally incorporate the incentive distorting problems associated with LEC-specific 'X' proposals.

7. A single 'X' framework is simple to implement. Its multiple 'X' counterpart is administratively costly and complex. Moreover, it can be demonstrated that implementing multiple X-factors cannot be accomplished by adopting conventional shortcuts and assumptions. Ignoring, for example, even very small differences in scale elasticities across LECs can be shown to reverse the conventional wisdom that LECS with higher output growth have higher productivity growth. Even commonly applied assumptions can be significant sources of regulatory bias in a multiple-X paradigm.

8. Any proposal to form multiple X-factors on the basis of differences in competitive circumstances is based on a fundamentally incorrect characterization of the relationship between competition and productivity growth. Competition may certainly affect a firm's productivity growth but it does so by altering the firm's incentives to pursue productivity growth, not by naturally and inevitably predetermining the firm's rate of productivity growth. In short, differences in competition induce endogenous responses by firms, i.e. any resulting variation in productivity growth is within the firm's control. Therefore, adjusting a single-industry 'X' for competitive differences may well introduce incentive-distorting biases into price-cap regulation.

9. The call for X-factor adjustments based on "competitive circumstances" derives, in reality, from the relationship between

competition and earnings and not from any relationship between competition and productivity growth. The problem is that if earnings differences due to competitive differences are the foundation for an 'X' adjustment, price-cap regulation effectively devolves into conventional rate-of-return regulation. The link between 'X' and productivity growth would be broken. The efficiency-inducing role of the X-factor would be weakened.

10. A single industry-average 'X' does not require grouping LECs into "like" subsets. A multiple-X adjustment process requires the grouping of LECs into homogeneous subsets. Economic principles offer no clear guidelines as to how to set boundaries among these groups.

11. A moving average under an industry-wide 'X' is sufficient to guarantee that ratepayers automatically share in 100% of productivity gains over the term of the moving average. No annual review of LEC performance is required. Under any multiple 'X' regime, however, continual review is required. A moving average applied to multiple 'X' factors is not a substitute for ongoing review. As business conditions change, the performance of individual LECs may deviate from the classification standards of their originally assigned 'X' subgroups. On-going review of LEC classifications will be required.

12. The moving average in a single 'X' paradigm eliminates the need to forecast future events. The moving-average process automatically blends changing market conditions into the governing single industry 'X'. In contrast, the assignment of LECs to X-adjustment classes requires properly forecasting changing business conditions. Only those LECs facing uniform forecasts of conditions that affect productivity and are beyond their control can be grouped together.

13. A single industry-average 'X' does not require the application of econometrics. The adjustment model requires econometrics not only to identify those business conditions that impact productivity growth and 'X' generally but also to quantify the effect of business-condition differentials on each LEC's productivity growth.

14. The data for a single industry 'X' are much more tractable than the data required by any LEC-specific or multiple 'X' framework. The latter paradigms are much more data intensive and may involve proprietary data.

15. The Commission should expect productivity growth rates to vary across LECs. A competitive market is a dynamic process. There are numerous sources of productivity growth that are within

each LEC's control and are not the result of external business conditions. That productivity growth rates vary across LECs is not a basis for a multiple-X paradigm.

The analysis presented below applies economic principles to develop each conclusion listed above. The analysis that follows adopts the criteria the Commission has established for evaluating alternative X-factor paradigms:

> ...the X-Factor adopted in our long-term price cap plan should have three essential characteristics. First, the X-Factor should be economically meaningful. That is, it should provide a reliable measure of the extent to which changes in LECs' unit costs have been less than the level of inflation. Second, the X-Factor should ensure that ongoing gains by the LECs in reducing unit costs are passed through to consumers. Third, calculation of the productivity offset should be reasonably simple and based on accessible and verifiable data. (Fourth FNPRM, Paragraph 16.)

II. X-FACTORS TAILORED TO INDIVIDUAL LECS

Paragraph 109 in the Fourth FNPRM states in part:

> "...At one extreme, we could establish an individually tailored X-factor for each price cap LEC, based on its performance....A single X-factor, however, would not adequately reflect differences in the economic conditions faced by each LEC and thus could unfairly penalize or reward LECs which face conditions that differ from the industry average. For example, there are variations among the LECs' service regions with respect to level of growth in the overall economy, the proportion of rural and urban areas for which service is provided, and level of competition in the provision of telecommunications services. Multiple X-factors allow the price cap plan to recognize that there are differences in the economic circumstances of the LECs. Thus, there is a strong argument for establishing multiple X-factors in the long-term price cap plan, so that the plan can be made to fit the particular circumstances of each price cap LEC. Accordingly, we invite parties to comment on the desirability of establishing a single X-Factor or, alternatively, more than one X-Factor..."

A. Incentive Regulation.

There understandably is considerable debate about the appropriate level of the X-factor. After all, that determines how the productivity pie is to be shared among the LECs and ratepayers. However, there should be little disagreement about the optimal size of the pie. Since productivity growth is unambiguously welfare improving, the X-factor must be designed so that maximizing productivity growth is in each LEC's own self-interest. Stated alternatively, the ultimately selected X-factor(s) must not break the link between self-interest and productivity growth.

Establishing LEC-specific X-factors that vary with company performance reduces each LEC's incentive to increase its productivity growth. After all, surpassing the 'X' set for the current period will only raise the X-factor in the next period. Productivity growth therefore has a lower payoff to each LEC. As a matter of public policy, setting LEC-specific 'X' factors is equivalent to imposing a tax on superior productivity performance and offering a subsidy for inferior performance. This is an unusual policy tack given that productivity growth is unambiguously welfare improving.

The implicit policy directive is that the X-factor(s) must be exogenous, beyond the LECs' control. If not, the LECs will have a perverse incentive to engage in strategic behavior, i.e. each LEC can influence the 'X' it will face in future periods by altering its current productivity enhancements. Unless the X-factor for each LEC is unaffected by the LEC's behavior, it will no longer be in the LEC's self-interest to maximize productivity growth. The "invisible hand" link between self-interest and productivity growth will be broken.

B. LEC-Specific 'X' Factors Are Inconsistent With Hallmark Features of a Competitive Market.

The primary hallmark feature of a competitive marketplace is the inability of any firm to affect the basic parameters of the market, especially price. In contrast, a firm is said to have "market power" if it can influence price. Permitting a LEC's behavior in the current period to influence its own 'X' in the next period is equivalent to giving the LEC market power over the prices it will charge in the next period. This produces a result in stark contrast to a competitive market.

With a LEC-specific 'X', a firm that performs at a level below its target 'X' subsequently receives a lower 'X' and thus is permitted to raise its price (technically, lower its price reductions) over time. A competitive market would not permit this behavior or, to state it more bluntly, a firm attempting to raise price to cover its inferior performance would do so at its own peril. Note, the single industry 'X'

surrogate for competitive incentives gives no firm market power over price and does not allow a firm to redeem its inferior performance by raising prices.

The Darwinian principles of a competitive market stimulate and reward productivity improvements, whether product innovations or cost reducing technological changes, and punish technological complacence. Contrast this with the incentive structure of a LEC-specific X-factor. As current productivity growth is used to set future minimum acceptable productivity targets, the LEC is punished for superior productivity growth through the recapture of efficiency gains with a higher 'X' in the next period and rewarded for inferior productivity performance with a lower 'X'. This is exactly the opposite of the incentive structure found in any competitive market.

The LEC-specific X-factor proposal takes its basis from the static model of competitive equilibrium taught in all principles of economics courses. Though a useful pedagogical device, there is no real-world counterpart to this static equilibrium. A competitive market is a living, dynamic process always in motion toward an ever-moving target, the competitive equilibrium.

A dynamic competitive market does not guarantee equal earnings among firms. Though all firms in a market face similar exogenously imposed competitive pressures, rates of return are not necessarily equal. Productivity performance levels are not necessarily identical. Some product and process innovations are successful, others are not. All that is guaranteed is equality of opportunity, the opportunity to "try out" in the competitive marketplace.

That LECs show evidence of different earnings levels or, as paragraph 109 puts it, "business conditions," does not necessarily infer that the LECs are not or should not be responding to the same competitive signals. In fact, one would expect variability around mean performance levels. Alfred Kahn makes a related point at pages 10-11 of his Affidavit in CC Docket 94-1 (Bell Atlantic Reply Comment dated 6/29/94):

> The competitive ideal is that risks of innovative ventures be borne not by ratepayers but by investors. In this model, ratepayers are not required to bear the losses stemming from unsuccessful investments; by the same token, neither are they permitted to appropriate the profits stemming from successful ones. The converse of this proposition is of course that if the risks are to be borne by the investors, they must see the opportunity of retaining the supernormal profits from successful ventures.

Competitive markets are not premised on equality of outcomes. A company-specific X-factor policy fails Kahn's competitive market hallmark of rewards and penalties for risk-taking behavior.

C. Productivity Growth in a Competitive Industry

The dynamic process of productivity growth in a competitive industry does not lead to identical rates of productivity growth across firms. Exogenous productivity improvements (those beyond the firms' control) may well impact all firms equally. Examples include improvements in the human capital content of laborers or the sudden availability of higher speed chips. But firms can also stimulate productivity growth with mechanisms within their control--investments in cost-saving technologies, introduction of new products that may take advantage of scale economies, and sizable investments in training and incentive programs for their own employees.

In the final analysis, one would expect productivity growth rates not to be identical or even necessarily similar across competitors. There are numerous sources of productivity growth that are within each firm's control. In the short and long runs, productivity growth rates will differ.

What is the competitive standard that forms the 'X' boundary between deserved rewards for superior productivity performance and deserved penalties for inferior performance? Only the "Invisible Hand" of a truly competitive market would provide an unambiguous answer. Lacking that, an industry-wide average 'X' is an excellent surrogate. Not only does it meet the required exogeneity standard, but an industry average 'X' definitionally includes the productivity effects of all exogenous productivity stimulants enjoyed by all LECs plus the average payoff to all productivity programs/investments that are within the LECs' control. That this latter component is positive is consistent with the fact that the average productivity performance of the telecommunications industry has consistently exceeded the average productivity growth rate for the U.S. economy.

D. LEC-Specific 'X' Compared to Rate-of-Return Regulation

The stick and carrot of price-cap regulation are sizable. Firms are rewarded for surpassing 'X'; they are penalized if they fail to achieve 'X'. Rate-of-return regulation, in contrast, has a much smaller stick and carrot. Firms are able to retain the reward of superior performance, but only for the period of regulatory lag. Symmetrically, they are made to experience the pain of inferior performance, but only for the period of regulatory lag. It is important to note, however, that the rate-of-return stick is slightly larger than its carrot. Rate-of-

return regulated firms run the risk of having imprudent costs disallowed.

Now consider price-cap regulation where each LEC's 'X' is tailored to its own productivity performance over time. Much like the rate-of return paradigm, the benefits of improving performance will be taxed away as 'X' is increased in the following period. Symmetrically, increasingly inferior productivity performance will not be penalized as 'X' automatically is reduced and price increased in the following period. Moreover, no disallowance mechanism, a form of consumer protection that exists under rate-of-return regulation, is operative when applying LEC-specific X-factors. (In contrast, a disallowance mechanism is effectively embedded in a single industry 'X' paradigm. Imprudent costs incurred by an individual LEC are not recoverable. They do not lower that LEC's X-factor.)

There also can be no expected administrative cost savings in a pure LEC-specific 'X' paradigm compared to its rate-of return alternative. The requirements of calculating and reviewing an annual X-factor for each LEC will require an annual data reporting and audit process not unlike a traditional rate hearing. After all, proper measurement of an X-factor based on productivity accounting will require detailed output, output price, input, and input price data--much the same data required by traditional cost-of service regulation.

E. Should LEC 'X' Vary With Competitive Conditions?

Assume for purposes of argument that (i) competitive conditions differ across LECs and (ii) these differences somehow naturally and inevitably are transformed into different productivity growth rates. (This models one case that is put forward justifying LEC-specific X-factors.) It would follow that different productivity growth rates would be observed for each LEC. The Commission asks in paragraph 109 how LEC-specific X-factors should be constructed to account for these differences. Some may propose using each LEC's measured productivity growth rate as its 'X'. After all, if productivity growth rates differ because of competitive differences in LEC environments, then what better basis to set 'X' for each LEC than to use its own measured productivity growth rate.

But note the circularity. Using measured productivity growth for a LEC's 'X' effectively presumes that the competitive environment within which the LEC operates forms the ideal competitive environment within which to calculate its X-factor. If competition is already at an ideal level, there is no need to apply an X-factor or, for that matter, price-caps. Stated equivalently, calculating a LEC-specific 'X' based on each LEC's productivity growth rate is tantamount to accepting the status quo level of competition facing each LEC as not

only (i) providing a sufficient productivity augmenting incentive to each LEC but also (ii) setting the proper sharing boundary of productivity gains between the LEC and its ratepayers.

A LEC-specific 'X' calculated wholly or largely on a LEC's productivity performance not only codifies the sufficiency of current competition in that LEC's market but, moreover, still has all the productivity-reducing incentives discussed above. Therefore, there is a fundamental philosophical problem with LEC-specific factors even before considering their incentive biasing problems.

An alternative would be to form a LEC-specific X-factor based on an average over "like" LECs. But which LECs should be in each set of "like" LECs? Those with identical productivity growth rates? If so, this reduces to the above case of calculating each LEC's 'X' based on its own productivity growth rate. If not, then one hasn't solved the problem put forward by those petitioning for relief from differing business conditions.

F. Adjustments to Industry 'X' for Other "Business Conditions"

Assume it is determined that differences in business conditions most likely cause different productivity thresholds and therefore should be used to form LEC-specific X-factors as adjustments to the industry-average 'X'. The relevant question becomes: How best to accomplish the task? The steps are clear:

(i) Only those business conditions that are beyond the LECs' control (exogenous) should be considered candidate adjustment factors.
(If the business conditions are within the LECs' control, then a LEC performing below the industry average 'X' can "climb" its way back to the industry 'X' while a LEC performing at a level above the industry average 'X' should be rewarded for its behavior.)

(ii) Narrow the candidate set to those business conditions that uniquely impact productivity.
(That business conditions differ or that they affect earnings is not sufficient. To be a candidate for an X-adjustment factor, the business condition must impact productivity.)

(iii) Via econometrics or some comparable technique, quantify the effect of changes in each exogenous business condition on productivity growth.

While the steps are clear, each step of the process and its result will be highly contestable and costly. This topic will be taken up again in the later discussion of the alternative multiple-factor paradigm

recommending distinct X-factors for subsets of "like" LECs. In that section, adjustments based on varying output growth will be evaluated.

G. Price-Cap Regulated LECs as Competitors

Assume LEC-specific X-factors are established for each company based on its own historical productivity growth in its home region and that these X-factors are set at different levels across LECs. Over time, LECs may enter each other's market areas. In fact, it is fair to say that such competitive entry is a desired policy objective.

Differing X-factors for competitors in the same market would certainly make no sense. In the limit, each LEC would have to have a set of multiple X-factors, one for each market within which it operates. Market-specific X-factors would require market-specific productivity studies and, to the extent common assets are used to provide service in multiple markets, would necessitate contentious cost-allocation rules. Moreover, facing a differing set of X-factors might induce LECs to allocate their resources across markets on the basis of differing X-factors rather than differences in true economic conditions. A single-industry 'X' not only avoids these problems but also recognizes that the LECs are increasingly becoming each other's strongest competitors.

H. Administrative Burden

Consider the administrative burden of LEC-specific X-factors calculated for the 7 to 10 largest companies. An industry-average 'X' needs to be computed only once every n years, where n is the length of years between reviews, or, at most, once each year if a moving-average industry-wide 'X' is formed. Alternatively, company-specific X-factors need to be computed every n years or, under a moving-average model, once each year. Since the proper calculation of 'X' requires all detailed output, output price, input, and input price data, the calculation of 'X' for each LEC effectively requires the data collection and auditing techniques of a traditional cost-of-service review. In addition, both the Commission and each LEC will find it necessary to compute what they judge to be the appropriate 'X', further raising the overall administrative costs of company-specific X-factors. Note, this unnecessary burden would be magnified many times over if state-specific X-factors are calculated for each LEC.

One of the prime welfare-improving virtues of price-cap regulation is its reduction in the administrative burden for both the LEC and regulators. The administrative costs associated with LEC-specific X-factors clearly represent a reduction in economic welfare.

Though all LECs would have a stake in an industry-wide 'X', each will clearly have a significantly greater self-interest in a company-specific or state-specific X-factor. One can readily surmise that there will be a much higher level of contestability among a far higher number of parties under a company-specific or state-specific format compared to a single industry-wide average 'X'. Therefore, unless there is the potential for significantly greater benefit from company-specific X-factors than from an industry-wide average 'X', the higher costs of LEC-specific adversarial proceedings translate into unambiguous welfare reductions.

I. Moving Average

The case for a moving average is persuasive. Attachment 1 of the USTA ex parte notice in this docket dated January 18, 1995 titled "Moving Average Productivity Offset" provides an excellent exposition of the argument. I offer only four additional comments.

(1) The consumer productivity dividend or "stretch" factor is premised on the assumption that incentive regulation would stimulate productivity growth beyond the rate-of-return period. The dividend insures that consumers would share in this surplus. While an understandable goal, one problem with the present dividend is that it is not set according to any definable set of rules. The virtue of the moving-average proposal is that it offers a well-defined metric for setting the consumer dividend. Moreover, the moving average metric assures that ratepayers get 100% of all benefits reflected by any increase in industry-average 'X'. Ratepayers receive the benefits, in the form of rate reductions, in equal installments over the term of the averaging process (say 5 years).

(2) The current form of price-cap regulation with its sharing mechanism appendage is really a hybrid paradigm of rate-of-return and pure price-cap regulation. Substituting a moving average for the consumer dividend moves the industry closer to true incentive regulation.

(3) Given that the FCC has tentatively adopted the position that "sharing" should be eliminated, the moving-average proposal facilitates this goal.

(4) Administratively, once the term and form of the moving average are set, there is no need to periodically recalibrate the consumer dividend. The averaging process automatically rebates to ratepayers the full benefit of productivity improvements.

III. X-FACTORS FOR SUBSETS OF LIKE LECS

Paragraph 110 of the Fourth FNPRM states in part:

> "If the long-term plan contains multiple 'X' factors, then we would need to determine the number and level of the 'X' factor alternatives...The additional X-Factors could reflect adjustments upward or downward from the industry-wide average level of changes in unit costs. We seek comment on criteria and methods of evaluation that could be used to determine such deviations from the industry average. One approach might be to base adjustments to the industry average on demand growth in a LEC's service region, under the supposition that changes in unit costs are related to changes in demand levels...In replicating a competitive market, it is important to include adjustments to the average 'X' factor only for circumstances outside the control of the LEC..."

A. Overview

The prima facie case for multiple 'X's requires that (a) economic conditions beyond the LECs' control vary across markets, (b) they vary in ways that are expected to naturally and inevitably influence the firms' productivity performance, and (c) the effects of these differences in economic conditions on industry-average 'X' can be quantified in ways consistent with economic principles. Given these conditions, economic principles can be used to design a correct set of steps that can and must be followed to construct multiple X-factors.

The bad news is that the process is quite complicated and, as will be shown below, its results are quite sensitive to simplifying assumptions. What might be viewed as necessary and otherwise innocent assumptions not only can introduce significant bias both in the calculation of the proper X-adjustments and the assignment of adjustment factors to individual LECs but also will likely introduce perverse incentives, encouraging LECs to reduce rather than enhance their productivity.

Adopting multiple X-factors therefore introduces significant risk into incentive regulation. In the end, even <u>if</u> business conditions vary and even <u>if</u> they are believed to affect a firm's potential performance, the simpler industry-average 'X' provides a superior form of incentive-pricing regulation.

B. Economic Principles

The analysis described below adopts the following "multiple X-factor" paradigm. X-factors are not tailored to each LEC. In contrast, a finite number of X-factors (perhaps two or three in number) are determined either by direct calculation of distinct X-factors for subsets of "homogeneous" LECs or by distinct adjustments (upward or downward) to the industry-wide 'X' for each homogeneous subset. The set of X-factors are moved over time via a moving average calculated on either industry-wide data or data for each homogeneous LEC subset.

The economic principles that would guide the formation of multiple X-factors are clear. First, any adjustment to 'X' and/or any grouping of LECs must be based on economic conditions that are wholly beyond the firms' control. If not, well-understood incentive problems arise. Second, the observed differences in economic conditions across LECs must persist over time. If not, the assignment of LECs to adjustment groupings and the magnitude of the appropriate adjustments to the industry-wide average 'X' will vary from year to year. Third, the measured differences in business conditions must naturally and inevitably lead to persistent differences in LEC productivity growth rates. Differences in business conditions that do not have such effects could not affect the firms' ability to achieve the industry-average 'X' and therefore should not be candidates as adjustment factors. In short, the candidate business conditions must affect productivity growth, not productivity levels.

This last point deserves elaboration. The industry-wide X-factor represents the difference in LEC and economy-wide productivity growth rates. Any proposed adjustment to the industry 'X' must be premised on the belief that productivity growth rates vary systematically across LECs. If so, the business conditions on which any adjustment is calibrated must impact productivity growth. Economic conditions that lead to different earnings levels across LECs or are responsible for different productivity levels across LECs do not satisfy the necessary conditions for candidate adjustment variables.

As an analogy, note that different soil conditions will affect productivity levels (e.g., yield per acre) in farming, but not necessarily productivity growth rates (the rate of change in yield per acre over time). Continuing the analogy, <u>persistent</u> differences across corn-producing states in rainfall conditions, average temperature conditions, and/or average days of sunshine are likely to affect productivity levels (yield) but not necessarily year-to-year changes in productivity growth (the rate of change in yields). Only those business conditions that unambiguously affect productivity growth should be considered candidate adjustment mechanisms. That they might affect productivity levels is simply inconclusive and therefore irrelevant.

It is similarly important to note that relative differences in productivity or earnings levels have no necessary implications for productivity growth rankings and, symmetrically, a relative ranking by productivity growth rates does not have any necessary inference for a relative ranking by productivity or earnings levels. For example, it is a well-established fact that the Japanese economy over the period immediately following World War II through the early 1970s had a significantly lower productivity level than the U.S. economy but enjoyed a significantly higher rate of productivity growth.

In short, just as the overall industry X-factor is based on a productivity growth differential relative to the U.S. economy average, any proposed upward or downward adjustment to the industry 'X' must be premised on productivity growth grounds. Variations in business conditions that affect productivity levels but not productivity growth cannot be bases for adjustments to 'X'.

C. The Adjustment Process

Applying the above economic principles leads to an unambiguous set of steps one must follow to form multiple X-factors. The problem is that the necessary steps are not only complex but also not amenable to simplifying assumption. The required steps are as follows. First, all economic characteristics that (a) persistently differ across LECs and (b) affect productivity growth (not levels) must be identified. Second, only that subset of characteristics that are truly beyond the LECs' control should be considered as candidate bases for adjustment or grouping. Third, the effects of changes in each characteristic on productivity growth must be quantified. Fourth, the differences (z-factors) between each LEC's characteristics and the industry-wide averages of each of those characteristics must be calculated. Fifth, a composite Z-score must be calculated for each LEC, where Z equals the sum of the products of each LEC's set of z-factors and the corresponding effects of deviations in those characteristics on productivity growth. Sixth, LECs must be grouped into homogeneous subsets not on the basis of common z-factors but on the basis of common Z-scores. Seventh, each subset's average Z-score can be added (Z can be positive or negative) to the industry-wide average 'X' to form adjusted X-factors for each LEC grouping.

Some comments on the practical implementation of these steps are in order:

(1) Econometrics is the most appropriate tool to identify (via tests of statistical significance) those business conditions that affect productivity growth (step 1) and to quantify the magnitude (the coefficient estimates) of the effect of change in each business condition on productivity growth (step 3). The strength of

econometrics is that it is a tool well-suited to the tasks outlined above. Its weakness is that agreement about proper econometric modeling techniques is subject to high variance.

(2) Considerable qualitative judgment will be required to distinguish (a) business conditions that are wholly within versus wholly beyond the LECs' control and (b) those parts of each varying business condition, e.g. output growth (see discussion below), that are beyond versus within LEC control (step 2). Similarly, unless company-specific adjustments are contemplated, appropriate and equitable groupings of LECs into "homogeneous" subsets based on Z-scores will be highly judgmental (step 6).

(3) Unless LEC groupings and adjustments to the industry-wide 'X' are to be keyed to year-to-year changes in each company's Z-score, some frequent review process must be implemented to review (a) petitions by LECs for reclassification and (b) staff petitions to initiate proceedings to change a LEC's classification.

Note, applying a moving average of industry-wide or LEC subset-specific X-factors will not finesse the need for review. If business conditions beyond the LECs' control do not move uniformly for all LECs initially assigned to a particular "homogeneous" subset to which a common X-adjustment is to be applied, those LECs whose true 'X' is impacted adversely by exogenous shifts in business conditions should rightfully be reclassified to another LEC subset for X-adjustment purposes. Note, this holds even if 100% of all underlying business conditions are truly exogenous. Business conditions simply may not move uniformly for all LECs pre-assigned to a common subset.

It is important to recognize that under this particular multiple-factor paradigm there are two required components to adjusting 'X' over time. First, a moving average of industry or subset-specific X-factors can and should be used to control for dynamic changes in factors affecting <u>average</u> 'X' over time. Second, some mechanism must be developed to control for the changing composition of LEC subsets over time. The two effects are independent. Average industry 'X' can change over time with or without any underlying uniform change in business conditions across LECs. Conversely, business conditions can change non-uniformly across LECs within each subset without any change in industry-average 'X'.

D. Differences in Output Growth Among LECs

The implementation difficulties outlined above can be made more concrete by focusing attention on how variation in a single business condition, LEC output growth, would properly enter a multiple X-factor adjustment paradigm. To keep the argument simple,

I will assume that variations in output growth are determined to be the only business condition that differs across LECs.

(Note, by focusing on output growth, I am not suggesting that Z-scores should be determined solely on the basis of variation in LEC output growth. Economic principles make clear that each LEC's Z-score must be calculated on the basis of all exogenous business conditions that are found to affect productivity growth. Excluding some relevant business conditions will bias each LEC's Z-score, will lead to biased adjustment factors, and may cause some LECs to be assigned to improper LEC subsets for X-factor adjustment purposes.)

I choose output growth because it is the most prominently mentioned basis for any potential adjustment mechanism. As paragraph 110 of the Fourth FNPRM states: "...One approach might be to base adjustments to the industry average on demand growth in a LEC's service region, under the supposition that changes in unit costs are related to changes in demand levels..."

Calculating an adjustment to the industry-wide 'X' based on output growth must follow the methodological steps outlined above:

Step 1(a). Assume recent history shows that output growth differentials (LEC growth relative to industry-average growth) exist across LECs. While past differentials may be the motivation for proposed adjustments to the industry 'X', they cannot be the basis for setting 'X'. If 'X' is to be an incentive-creating surrogate for conditions in a competitive market, any adjustment to 'X' must be premised on a forecast revealing that past output growth differentials are expected to persist into the future. If output growth differentials do not persist, X-factor adjustments and the assignment of LECs to groups to which common adjustments will be applied will have to be altered as soon as output differentials change.

For purposes of argument, it is assumed that all credible forecasts indicate that output growth differentials are likely to persist.

Step 1(b). Assume the collective wisdom of existing econometric and engineering studies seems to indicate that variations in output growth are likely to affect, among other things, productivity growth. In particular, the following discussion assumes the existence of scale economies, a condition generally believed to be true and without which an adjustment based on output growth differentials makes no sense.

Step 2. If and only if the observed variation in some business condition is determined to be wholly beyond the LECs' control should it be considered a basis for either assigning a LEC to a particular subset or making an adjustment to industry 'X'. The reality is that

output growth is neither totally beyond nor wholly within a LEC's control. Growth resulting from population growth, housing growth, or business growth is arguably largely beyond the firm's control (exogenous). Output growth resulting from marketing efforts and/or new product innovations, however, is wholly within the firm's control. Since output-growth stimulated productivity growth is unambiguously welfare improving, only differences among LECs in exogenous components of output growth (as explicitly recognized by the Commission in paragraph 110) should be considered candidate bases for grouping LECs into like subsets and ultimately determining the magnitudes of appropriate adjustments to the single industry 'X'.

This decomposition of overall LEC output growth into "within" and "beyond" firm control components cannot be finessed. Adjusting 'X' on the basis of overall LEC output growth would induce strategic behavior by each LEC. The potential payoff to a LEC for a new product innovation would be reduced if its successful introduction would stimulate output growth and therefore cause it to be assigned to a higher X-adjustment class in the next period.

An alternative to decomposing each LEC's output growth into "within" and "beyond" LEC control categories is to infer exogenous output growth rates from observed growth rates in population and/or business trends in the LEC's region. This approach, however, ignores the process of competitive entry. High (low) growth areas are likely to attract (dissuade) competitive entry. Exogenous regional output growth differentials based, for example, on simple population growth rates must be adjusted for the growth in the output of competitors in each region. Neglecting to do so would most likely upward bias the derived "output growth adjustments" for the price-cap regulated LECs.

For purposes of argument, let us assume that these problems are resolved. Some technique (albeit currently unknown) is developed either to decompose overall LEC output growth into components within and beyond each LEC's control or to resolve how regional growth trends can be adjusted for competitive entry.

Step 3. Differences in output growth (whether within or beyond the LEC's control) do not by themselves determine productivity growth differences and therefore are insufficient bases on which to either derive adjustment factors or to group LECs into homogeneous subsets. If output growth affects LEC productivity growth, the magnitude of the effect depends on <u>both</u> the amount of output growth <u>and</u> the extent of scale economies. (This is the basis for the following clause in paragraph 110: "...under the supposition that changes in unit costs are related to changes in demand levels".) If subsets of LECs differ in fundamental ways (presumably a maintained premise for this discussion), then differences in output volume, product mix, customer mix, customer density, etc. may likely affect the extent of scale

economies available to each LEC. If so, consistency requires that LEC-specific estimates of scale economies need to be determined as a prerequisite step both to deriving an appropriate Z-score for each LEC as well as to ultimately assign each LEC to the appropriate subset of homogeneous LECs.

In short, if one is willing to believe that differences in output growth matter, then consistency requires that one recognize that differences in scale economies can matter as well. It is not appropriate to assume, without basis, that scale economies, even if believed to be an industry-wide phenomenon, are identical across LECs.

This is critical because small differences in scale elasticities can and do matter. As an illustration, consider two LECs. The first has a persistent 10% annual output growth rate and a scale elasticity of .97 (indicating that a 0.97 percent change in its costs result from a 1.0% change in output). The second LEC has a .94 scale elasticity and a persistent 5% annual growth rate of output. The two firms have significantly different output growth rates and only slightly different scale elasticities. Examining output growth rates alone might lead one to conclude that the two firms should receive different adjustments to industry 'X'. However, this would be incorrect.

Recall that the effect of output growth on productivity growth equals the product of output growth and one minus the scale elasticity. Applying this algorithm to the two hypothetical LECs leads to the following computation:

	Δ Productivity Growth	=	Δ output growth	*	(1- scale elasticity)
Firm 1:	.003	=	.10	*	(1-.97)
Firm 2	.003	=	.05	*	(1-.94)

The slight difference in scale economies for the two LECs is sufficient to offset the importance of the significantly differing output growth rates and leads to the conclusion that the effects of differing output growth rates on the LECs' productivity growth (and therefore 'X') are identical.

Slight differences in scale economies may mitigate the measured effect of even sizable differences in output growth rates (whether within or beyond the firm's control). To assume that productivity differences are driven by output growth differences without consideration given to potential differences in scale economies is not only incorrect but can introduce a significant source of bias.

It should also be noted that had Firm 1 in the above illustration exhibited constant returns to scale (a scale elasticity equal to 1.0), output growth would have had no impact on its productivity growth or unit costs. Firm 2, with a .94 scale elasticity, would have experienced a 0.3 percent increase in its productivity growth, in spite of the fact that its output growth was only half that of Firm 1. There is no necessary correlation between output growth and productivity growth.

Finally, three technical notes. First, one cannot finesse the above issue by computing an "average" scale elasticity for all LECs assigned to some common output growth group. To begin with, there is no basis to assume that LECs sharing common output growth rates share an identical scale elasticity. Moreover, small differences in scale elasticities matter. Second, LECs cannot be grouped until their composite Z-scores have been calculated. This cannot be done until the extent of scale economies is determined for each LEC. Third, the need to derive LEC-specific scale elasticities involves not only a considerable amount of effort but also unavoidably involves econometrics, thus opening the potential for debate about, at a minimum, proper modeling techniques.

Step 4. An industry-wide estimate (via econometrics) of an average scale elasticity for all LECs must be computed. This provides the industry benchmark against which each LEC's differential can be calculated.

Steps 5 and 6. Based on some qualitative decision model, LECs are grouped into a finite number of subsets on the basis of their Z-scores, which in this simple example is based wholly on each LEC's scale effect--the product of its output growth and one minus the estimate of its scale elasticity. The number of subsets must be large enough to avoid inappropriately grouping unlike LECs into common groups. Simultaneously, the number of subsets must be small enough to avoid having so few LECs within each subset that the well-understood incentive problems associated with the LEC-specific model of X-factors arise.

Step 7. Average Z-scores are calculated over the LECs within each subset. The average Z-scores are the appropriate differentials by which to adjust the industry-wide 'X' for each LEC subset.

It is important to emphasize that if exogenous output growth does not uniformly affect all LECs within a homogeneous subset, some review process will have to be established to permit reclassification based on changing output growth patterns. This issue, note, is not addressed by a moving-average process. A moving average affects the movement of the base 'X' over time. Non-uniform volatility in output growth may indicate that some LECs are part of the wrong base 'X' grouping.

The above process is quite complicated but, unfortunately, each step is necessary. Consider the strong assumptions underlying some simplifying alternatives. In particular, assume LECs are somehow grouped into high, medium, and low output growth categories. High and low growth LECs might be given arbitrary +0.5 and -0.5 adjustments, respectively, to industry 'X'. This model assumes (a) the mix of exogenous and endogenous sources of output growth differentials are identical across all LECs, (b) observed past output growth differentials are expected to persist into the future, (c) all LECs have identical scale elasticities, and (d) changes in business conditions are expected to affect all LECs (high, medium, and low growth LECs) uniformly.

Alternatively, assume high, medium, and low output growth LECs are distinguished as above but in place of standard +0.5 and -0.5 adjustments to 'X', average X-factors are calculated over all LECs within each grouping. This model adopts the same four assumptions as the preceding model and, in addition, further assumes that all of the resulting differences in the X-factors for high, medium, and low output growth groups are due to exogenous factors beyond the firms' control. Note the importance of this last assumption. If it has no basis in fact, all the multiple X-factor model will have accomplished is to have rewarded LECs with below-average productivity growth performance and to have penalized those with above-average productivity growth. Strategic behavior will have been encouraged. The link between 'X' and the incentive system of a competitive market will have been broken.

The important conclusion is that adopting multiple X-factors is no easy task. Adopting simplifying assumptions, most notably identical scale elasticities, can be the source of significant bias. Ignoring as small a true difference in scale elasticities as 0.03 can mask the reality that there may be absolutely no difference in the productivity growth consequence of 5% output growth for one LEC and 10% for another.

E. Differences in Competition Across LEC Markets

> **Issue 19b, Second FNPRM:** If we adopt mandatory X-Factors, should we include considerations based on competitive circumstances in our assignment of an X-Factor to each LEC? Should the higher X-Factors be assigned to LECs facing less competition or more competition? What methods of measuring the extent of competition would be appropriate for this purpose?

The second most prominent candidate nominated as a basis for adjusting an industry-wide 'X' is differences in competition facing

LECs. The principal problem with this suggestion is that it is based on a fundamentally incorrect characterization of the relationship between competition and productivity growth. An exogenous business condition (discussed in detail above) becomes a prima facie candidate for an adjustment factor if and only if it is determined that variations in the business condition naturally and inevitably diminish or augment a LEC's productivity growth. The business condition must be such that the LEC cannot control the response of its productivity growth to changes in the business condition. Variations in the "extent of competition" simply do not meet this exogeneity standard.

Competition may certainly affect a firm's productivity growth but it does so by altering the firm's incentives to pursue productivity growth, not by naturally and inevitably predetermining the firm's rate of productivity growth. In short, differences in competition induce endogenous responses by firms, i.e. any resulting variation in productivity growth is within the firm's control. Therefore, adjusting a single-industry 'X' for competitive differences may well introduce incentive-distorting biases into price-cap regulation. The desired strategy is to establish a single incentive-signaling 'X', a carrot for some, a stick for others.

It is also important to emphasize that, as a matter of economic principles, current differences in actual competitive conditions are not as important as one might first think. Potential competition is as much a stimulant of productivity growth as is actual competition. Those LECs currently encountering significant levels of actual competition in selected markets have no more or less incentive to enhance their productivity than do LECs currently facing less competition. The former strive for productivity gains in response to actual competition. The latter strive equally diligently in response to potential competition. Economic principles make clear that the threat of entry influences economic behavior just as does actual entry. Moreover, it must not be forgotten that those LECs currently facing less competition than others are still confronted by the X-factor. 'X' is the mechanical heart mimicking competitive Darwinian pressures.

The second fundamental problem with adjusting an industry 'X' for competitive differences across LECs is (as inferred by the second sentence in the Commission's statement of Issue 19b) that there is no clear inference to be drawn from any observed correlation between the state of competition in a market and the average rate of productivity growth within that market.

The direction of causation is not clear a priori. For example, if above-average productivity growth rates and above-average competition are correlated, is the high level of productivity growth a result of competitive pressure or is competitive entry being induced by above-average productivity growth and earnings? Alternatively, if below-

average productivity growth rates are correlated with above-average competition, is competitive pressure somehow reducing the potential for investment in productivity improvements or are observed low rates of productivity performance inducing entry by firms believing they can out-perform the dominant incumbents?

Any proposal to adjust a single industry 'X' for differing extents of competition must be premised on the belief that the direction of causation flows from changes in competition to changes in productivity growth. The difficulty is that the direction of causation cannot be determined from theory. It is fundamentally an empirical question--and a very complex one. Econometric models can be used to determine the direction of causation, but econometrically modeling simultaneous equations is a highly complex and, in this context, contentious exercise.

Finally, even if it is decided that competitive differences should be used to adjust a single industry 'X', it is not obvious how one would proceed to make such an adjustment. In brief, how is "competition" to (a) be measured and (b) converted into some metric for adjustment purposes?

The reality is that the call for X-factor adjustments based on "competitive circumstances" derives from the relationship between competition and earnings and not from the relationship between competition and productivity growth. If 'X' is to serve as an incentive mechanism inducing efficiency gains, any adjustment to 'X' based on competitive differences should be based on some conceptually sound and empirically verifiable relationship between competition and productivity growth, not between competition and earnings. If earnings differences due to competitive differences are the foundation for an 'X' adjustment, price-cap regulation effectively devolves into conventional rate-of-return regulation. The link between 'X' and productivity growth would be broken. The efficiency-inducing role of the X-factor would be weakened.

IV. THE CASE FOR A SINGLE INDUSTRY 'X'

The following excerpt is taken from paragraph 193 of the Commission's "First Report and Order" in Docket No. 94-1 released April 7, 1995:

> ...The data obtained from the initial period of price cap regulation indicate that the efficiency gains that individual LECs have been able to sustain, as measured by their interstate earnings, have indeed varied significantly. In each

> year under price caps, the range of earnings of the LECs has spanned several hundred basis points. Some of the LECs have achieved efficiency gains that placed them in the sharing zones every year, while others have lagged significantly behind....We recognize that these differences among the price cap LECs may be attributable to differences in their responses to the incentives created by this scheme of regulation to improve their efficiency in providing their regulated services. We also recognize that in some cases these differences may be caused by factors over which the LECs have no control, such as the strength of the regional or local economies in the areas in which a LEC provides service. Since at this time we are unable to isolate the factors that contributed to a particular LEC's performance, the precise cause of the variations among companies is less important than the fact that the heterogeneity exists.

This text reflects, quite frankly, a very cavalier attitude toward establishing multiple X-factors. First, the basis for establishing multiple X-factors appears to be observed differences in past earnings. As discussed above, past differences are not the appropriate basis for altering future X-factors. Second, differences in earnings levels or rates of return should not be the basis for adjustments to 'X'. The appropriate basis for an adjustment to 'X' must be premised on some business condition that leads to a change in productivity growth, not to differing levels in measured rates of return. Third, factors within the LECs' control are acknowledged to be potential sources of measured earnings differences. Adjusting X-factors may therefore distort the very efficiency-inducing incentives price-cap regulation is designed to achieve. Fourth, the reference to "the strength of regional or local economies" finesses the need to determine whether these differences affect productivity growth rates or levels and ignores the requirement to examine differential scale elasticities among LECs. (Recall, even small differences in this parameter can significantly affect inferences.)

The last sentence in the cited text is especially troubling. It effectively asserts that differences in earnings are sufficient bases for establishing different X-factors, regardless of the source of these differences and without regard to whether or not the resulting multiple X-factors will distort incentives. The sentence seems to be premised on the belief that differences in earnings somehow rebut the premise that LECs are and should be responding to the same competitive pressures..."the precise cause of the variations among companies is less important than the fact that the heterogeneity *in earnings* exists" (emphasis added). The inference is that past, short run differences in productivity levels, productivity growth rates, and/or earnings are necessarily incompatible with a single 'X' paradigm.